National Park Service
U.S. Department of the Interior

Air Resources Division
Natural Resource Stewardship & Science
Denver, Colorado

Methods for Determining Air Quality Conditions and Trends for Park Planning and Assessments

The National Park Service (NPS) Air Resources Division (ARD) has developed an approach for assessing air quality conditions and trends within NPS units. This approach is used in the ARD's 2010 annual report, "Air Quality in National Parks." The most recent report is available at http://www.nature.nps.gov/air/who/npsPerfMeasures.cfm.

Condition Assessment

The Air Resources Division (ARD) uses all available monitoring data over a five-year period to generate interpolations for each air quality indicator (ozone, wet deposition, and visibility) in the contiguous United States. Sites must have at least 3 years of annual data to be included. Monitors used include NPS, Environmental Protection Agency (EPA), state, tribal, and local monitors. These interpolations produce estimates of air quality parameters at all NPS units located within the contiguous United States, including many without on-site monitoring. Estimates and conditions are not available for most parks in Alaska and the Pacific Islands because data are too sparse to interpolate (on-site monitor data are used to derive the condition category estimates for Denali NP & PRES, Virgin Islands NP, Hawaii Volcanoes NP, and Haleakala NP). Estimates for ozone, wet deposition, and visibility are assigned to one of three condition categories:

- Warrants Significant Concern,
- Warrants Moderate Concern, or
- Resource is in Good Condition.

In the air quality summary tables, the condition is represented by the color of the circle, where red represents *Warrants Significant Concern*, yellow represents *Warrants Moderate Concern*, and green represents *Resource is in Good Condition*.

Ozone, total (nitrogen and sulfur) wet deposition, and visibility indicators are rolled into a single score for an overall air quality condition and trend within an NPS unit. NPS units that are in EPA designated ozone or particulate matter nonattainment counties are automatically placed in the *Warrants Significant Concern* condition category for overall air quality.

The procedures for assigning these categories are described below.

Ozone Condition

Ozone can harm both humans and plants. The Environmental Protection Agency's (EPA) ozone standard is used as a benchmark for rating ozone condition. This standard was revised in 2008 in order to be more protective of human health. To attain this standard, the 3-year average of the annual 4th-highest daily maximum 8-hour average ozone concentrations measured at each monitor must not exceed 75 parts per billion (ppb). For parks within the contiguous U.S., ozone condition is estimated from the interpolation of the five-year averages of 4th-highest daily maximum

8-hour ozone concentration. For sites outside the contiguous U.S., ozone condition is based on five-year averages computed from on-site data.

If the resulting five-year average is greater than or equal to 76 ppb then the condition *Warrants Significant Concern* is assigned to that park. *Warrants Moderate Concern* condition for ozone is assigned to parks with average five-year 4th-highest daily maximum8-hour ozone concentrations from 61 to 75 ppb (concentrations greater than 80 percent of the standard). *Resource is in Good* Condition is assigned to parks with average five-year ozone concentrations less than 61 ppb (concentrations less than 80 percent of the standard).

Ozone Condition	Ozone concentration[1] (ppb)
Warrants Significant Concern	≥ 76
Warrants Moderate Concern	61–75
Resource is in Good Condition	≤ 60

Condition Adjustments: In instances where the NPS unit falls within a county designated by the EPA as "nonattainment" (not meeting) for the ground-level ozone standards of an 8-hour average concentration of 75 ppb, the ozone condition is adjusted to the *Warrants Significant Concern* category (see Appendix A: Ozone Condition Adjustments).

In addition to attainment of the ozone standard, vegetation sensitivity is considered for ozone condition assessment. Data show that some plant species[2] are more sensitive to ozone than humans and the ozone standard is not protective of some vegetation. Ozone injury to vegetation has been documented at a number of parks, including Great Smoky Mountains National Park, Shenandoah National Park, and Sequoia and Kings Canyon National Parks.

A risk assessment rated parks at low, moderate, or high risk for ozone injury to vegetation, based on presence of sensitive plant species, ozone exposures,[3] and environmental conditions, i.e., soil moisture (Kohut 2007). If parks were evaluated at high risk for ozone injury to vegetation, the condition category is adjusted to the next worse condition category (see Appendix A: Ozone Condition Adjustments).

[1] "Ozone concentration" represents the 4th-highest daily maximum 8-hour average ozone concentration averaged over five years.

[2] Lists of ozone sensitive species, by park, are available from NPSpecies (https://irma.nps.gov/App/Species/Search/grpsplst/qryslmoss/lytosvt).

[3] The ozone risk assessment for injury to vegetation was based on ozone exposures over the growing seasons from 1995–1999. The ozone exposure metrics are described in the ozone risk assessments at http://www.nature.nps.gov/air/permits/aris/networks/ozonerisk.cfm.

Atmospheric Deposition Condition

Atmospheric deposition of nitrogen and sulfur compounds can acidify sensitive lakes, streams, and soils, disrupt soil nutrient cycling, and affect biodiversity. Conditions of atmospheric deposition are based on wet deposition only because dry deposition data are not available for most areas. Wet deposition for sites within the contiguous U.S. is calculated by multiplying nitrogen[4] or sulfur[5] concentrations in precipitation by a normalized precipitation amount.[6] For sites outside the contiguous U.S., where interpolations cannot be calculated and normalized precipitation amounts are not available, five-year averages of on-site deposition are used. Deposition data are obtained from the National Atmospheric Deposition Program.

Evidence is not currently available indicating that wet deposition amounts less than 1 kilogram per hectare per year (kg/ha/yr) cause ecosystem harm. Therefore, parks with wet deposition less than 1 kg/ha/yr are assigned *Resource in Good Condition*; parks with 1–3 kg/ha/yr are assigned *Warrants Moderate Concern*; and parks with greater than 3 kg/ha/yr are assigned *Warrants Significant Concern* for deposition.

Deposition Condition	Wet Deposition (kg/ha/yr)
Warrants Significant Concern	> 3
Warrants Moderate Concern	1–3
Resource is in Good Condition	< 1

Condition Adjustments: National assessments identified ecosystems and resources in national parks at risk for acidification and excess nitrogen enrichment. The reports provide a relative risk assessment of acidification and nutrient enrichment impacts from atmospheric nitrogen and sulfur deposition for 270 parks in 32 inventory & monitoring networks. If park ecosystems are ranked very high in sensitivity[7] to nutrient enrichment or acidification effects from atmospheric deposition relative to all inventory & monitoring parks (Sullivan et al. 2011a; Sullivan et al. 2011b), the condition category is adjusted to the next worse condition category (see Appendix B: Atmospheric Deposition Condition Adjustments).

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[4] Total nitrogen is estimated using molecular weight ratios to calculate the nitrogen portions of NO_3 (NO_3 * 0.22581) and NH_4 (NH_4 * 0.77778).

[5] Wet sulfur deposition includes sulfate (SO_4). Total sulfur is estimated using molecular weight ratios to calculate the sulfur portion (SO_4 * 0.3338).

[6] Normalized 30-year precipitation values from the PRISM database are used to calculate deposition in order to minimize interannual variation in deposition caused by interannual fluctuations in precipitation (http://www.ocs.orst.edu/prism/).

[7] Ecosystem sensitivity relative ratings to acidification from atmospheric deposition were based on percent sensitive vegetation types, number of high-elevation lakes, length of low-order streams, length of high-elevation streams, average slope, and acid-sensitive areas within the park (Sullivan et al. 2011a). Ecosystem sensitivity relative ratings to nutrient enrichment effects from atmospheric nitrogen deposition were based on percent sensitive vegetation types and number of high-elevation lakes within the park (Sullivan et al. 2011b).

Visibility Condition

Air pollution causes haze and reduces visibility. Visibility is measured using the Haze Index[8] in deciviews (dv). As the Haze Index increases, the visibility worsens. Conditions for visibility are based on five-year average visibility minus estimated average natural visibility,[9] where average visibility is the mean of visibility between 40th and 60th percentiles. Interpolated 5-year averages are used within the contiguous U.S. For sites outside the contiguous U.S., visibility condition is based on five-year averages computed from on-site data. The visibility condition is expressed as:

Visibility Condition = average current visibility – estimated average natural visibility.

Resource is in Good Condition category is assigned to parks with visibility 2 dv above natural conditions. Parks with visibility ranging from 2 to 8 dv above natural conditions are considered to be in the *Warrants Moderate Concern* category, and parks with visibility greater than 8 dv above natural conditions are considered to be in the *Warrants Significant Concern* category. The dv ranges of these categories were chosen to reflect the variation in monitored visibility conditions.

Visibility Condition	Average visibility – estimated average natural conditions (dv)
Warrants Significant Concern	> 8
Warrants Moderate Concern	2–8
Resource is in Good Condition	< 2

Condition Adjustments: Visibility condition assessments are based on interpolated 5-year average haze index values without any adjustments.

Degree of Confidence for Condition Assessments

Degree of confidence is based on how well the nearest monitoring site(s) represents air quality reported for a park. The representativeness of a monitor depends on the pollutant, network, distance from the park, and local site characteristics. The degree of confidence is rated as either *High* or *Medium*: the confidence is *High* if estimates are based on interpolated data from on-site or nearby monitors, and *Medium* if estimates are based on interpolated data from more distant monitors. On the air quality summary table, the degree of confidence is represented by the thickness of the outside line of the condition/trend symbol and represents confidence in the condition only.

[8] The Haze Index is a measure of visibility derived from calculated light extinction (EPA-454/B-03-005).

[9] Natural visibility conditions are those estimated to exist in a given area in the absence of human-caused visibility impairment. The Clean Air Act established a goal of restoring visibility in all Class I areas to natural conditions (EPA-454/B-03-005). See Appendix D for a table listing estimated average natural visibility in NPS units.

Trend Assessment

Unlike the condition estimates, which are derived from interpolated data, trends are computed from data collected over a ten-year period at on-site or nearby monitors (within 10 kilometers of the park for ozone, 16 kilometers of the park for wet deposition, and 100 kilometers of the park for visibility). A non-parametric regression technique called the Theil method is used to determine statistically significant trends of ozone, wet deposition, and visibility. Trends are calculated for sites that have at least 6 years of annual data and an annual value for the final year of the 10 year period.

On the air quality summary table, trends are represented by arrows. All improving (up arrows) and deteriorating (down arrows) trends have at least 95% probability of being correct (those with p-values ≤ 0.05). Statistically significant (p-value ≤ 0.05) trends with zero slope are represented by flat arrows. Parameters with no statistically significant trend (p-value ≥ 0.05) are also represented by flat arrows.

Ozone

Annual fourth-highest daily maximum 8-hour average ozone concentrations (ppb) are used to calculate ten-year trends for ozone.

Atmospheric Deposition

Wet deposition trends are evaluated using pollutant concentrations in precipitation (micro equivalents/liter) so that yearly variations in precipitation amounts do not influence trend analyses. For sulfur wet deposition trends, sulfate concentrations measured in precipitation are trended over a ten-year period. To assess the ten-year trend for nitrogen wet deposition, total nitrogen in precipitation is estimated using molecular weight ratios[10] to calculate the nitrogen portions of nitrate and ammonium. The resulting ratios are summed to estimate total nitrogen concentration in precipitation and trended over a ten-year period.

Visibility

Visibility trends are computed from the Haze Index values on the 20% haziest days and the 20% clearest days, consistent with visibility goals in the Clean Air Act, which include improving visibility on the haziest days and allowing no deterioration on the clearest days. If the Haze Index trend on the 20% clearest days is deteriorating, the overall visibility trend is reported as deteriorating. Otherwise, the Haze Index trend on the 20% haziest days is reported as the overall visibility trend.

Degree of Confidence for Trend Assessments

The degree of confidence for all available trend analyses is rated *High* because trends are only computed for parks with an on-site or nearby monitor.

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[10] Total nitrogen is estimated using molecular weight ratios to calculate the nitrogen portions of NO_3 (NO_3 * 0.22581) and NH_4 (NH_4 * 0.77778).

Reporting Overall Air Quality

Ozone, total (nitrogen and sulfur) wet deposition, and visibility indicators are rolled into a single score for an overall air quality condition and trend within an NPS unit.

Condition

To determine an overall air quality condition, the three main indicators (ozone, wet deposition, and visibility) are averaged by assigning point values to each condition category. Overall wet deposition condition is determined by the sulfur or nitrogen condition of most concern, e.g. if sulfur is rated *Resource is in Good Condition* and nitrogen is rated *Warrants Moderate Concern*, the overall wet deposition condition is *Warrants Moderate Concern*.

Each indicator in the *Warrants Significant Concern* category is assigned nine points, each indicator in the *Warrants Moderate Concern* category is assigned five points, and each indicator in the *Resource is in Good Condition* category is assigned one point. The points for ozone, wet deposition, and visibility are averaged, and the resulting value is compared to the scale below to determine overall air quality condition.

Overall Condition Adjustments: NPS units that are in EPA designated ozone or particulate matter nonattainment counties are automatically placed in the *Warrants Significant Concern* condition category (see Appendix C: Overall Air Quality Condition Adjustments).

Overall Air Quality Trend		
Score 1 to ≤ 3	Score > 3 to ≤ 6	Score > 6 to 9
Resource in Good Condition	Warrants Moderate Concern	Warrants Significant Concern

Degree of Confidence for Overall Condition Assessment

Overall degree of confidence in the condition assessments is assigned a *High* rating only when all three indicators (ozone, wet deposition, and visibility) have *High* ratings. In all other instances, the overall degree of confidence is rated as *Medium*.

Trend

To determine the overall air quality trend, three main indicators (ozone, wet deposition, and visibility) are averaged by assigning point values to each trend category. The wet deposition sulfur and nitrogen trend symbols are combined to create one trend symbol by choosing the trend of most concern to represent wet deposition, where an unchanging trend is of more concern than an improving trend. If an indicator does not have a statistically significant trend, it is not included in the overall air quality trend calculation. Consequently, in some cases, only one indicator trend may represent the overall trend.

Each indicator in the *Deteriorating* trend category is assigned nine points, each indicator in the *Unchanging* category is assigned five points, and each indicator in the *Improving* trend category is assigned one point. The points for ozone, wet deposition, and visibility are averaged, and the resulting value is compared to the scale below to determine overall air quality trend.

Overall Air Quality Trend		
Score 1 to ≤ 3	Score > 3 to ≤ 6	Score > 6 to 9
Improving Trend	Unchanging	Deteriorating Trend

References

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Appendix A: Ozone Condition Adjustments

Risk for Ozone Injury to Vegetation

A risk assessment rated parks at low, moderate, or high risk for ozone injury to vegetation, based on presence of sensitive plant species, ozone exposures, and environmental conditions, i.e., soil moisture (Kohut 2007). If parks were evaluated at high risk for ozone injury to vegetation, the condition category is adjusted to the next worse condition category. The table below lists NPS units evaluated at high risk for ozone injury to vegetation.

NPS units evaluated at high risk for ozone injury to vegetation (Kohut 2007)	
Antietam NB	John Muir NHS
Assateague Island NS	Joshua Tree NP
Big South Fork NRRA	Kennesaw Mountain NBP
Big Thicket N PRES	Kings Mountain NMP
Cape Cod NS	Lincoln Boyhood N MEM
Catoctin Mountain Park	Little River Canyon N PRES
Chattahoochee River NRA	Mammoth Cave NP
Chickamauga & Chattanooga NMP	Manassas NBP
Chickasaw NRA	Manzanar NHS
Chesapeake & Ohio Canal NHP	Mojave N PRES
Colonial NHP	Monocacy NB
Cowpens NB	Morristown NHP
Cumberland Gap NHP	Obed WSR
Cuyahoga Valley NP	Ocmulgee NM
Devils Postpile NM	Ozark NSRs
Delaware Water Gap NRA	Pinnacles NM
Eisenhower NHS	Prince William Forest Park
Fire Island NS	Rock Creek Park
Fort Donelson NB	Sagamore Hill NHS
Fort Necessity NB	Santa Monica Mountains NRA
Friendship Hill NHS	Sequoia & Kings Canyon NPs
Fredericksburg & Spotsylvania NMP	Shiloh NMP
Gateway NRA	Sleeping Bear Dunes NL
Gettysburg NMP	Stones River NB
George Washington Birthplace NM	Thomas Stone NHS
Great Smoky Mountains NP	Upper Delaware SRR
Guilford Courthouse NMP	Valley Forge NHP
George Washington Memorial PKWY	Weir Farm NHS
Harpers Ferry NHP	Whiskeytown NRA
Hopewell Culture NHP	Wolf Trap NP for the Performing Arts
Hopewell Furnace NHS	Yosemite NP
Indiana Dunes NL	

NPS Units in EPA Designated Ozone Non-Attainment Counties

Where the NPS unit falls within a county designated by the EPA as "nonattainment" (not meeting) the ground-level ozone standards of an 8-hour average concentration of 75 ppb, the ozone condition is adjusted to the *Warrants Significant Concern* category. The overall air quality condition is also automatically placed in the *Warrants Significant Concern* category for NPS units that are in ozone non-attainment counties.

NPS units in EPA designated 8-hour ozone nonattainment counties (2008 Standard)		
African Burial Ground NM	General Grant N MEM	Piscataway Park
Antietam NB	George Washington Memorial PKWY	Point Reyes NS
Arlington House, The Robert E. Lee Memorial	Golden Gate NRA	President's Park (White House)
Big Thicket N PRES	Governors Island NM	Prince William Forest Park
Cabrillo NM	Great Smoky Mountains NP	Rock Creek Park
Carter G. Woodson Home NHS	Greenbelt Park	Rocky Mountain NP
Castle Clinton NM	Hamilton Grange N MEM	Rosie the Riveter WWII Home Front NHP
Catoctin Mountain Park	Hampton NHS	Sagamore Hill NHS
Channel Islands NP	Harpers Ferry NHP	Saint Paul's Church NHS
Chattahoochee River NRA	Hopewell Furnace NHS	San Francisco Maritime NHP
Chesapeake & Ohio Canal NHP	Independence NHP	Santa Monica Mountains NRA
Clara Barton NHS	Indiana Dunes NL	Sequoia & Kings Canyon NPs
Constitution Gardens	James A Garfield NHS	Statue Of Liberty NM
Cuyahoga Valley NP	Jefferson National Expansion Memorial	Thaddeus Kosciuszko N MEM
Delaware Water Gap NRA	John Muir NHS	Theodore Roosevelt Birthplace NHS
Devils Postpile NM	Joshua Tree NP	Theodore Roosevelt Island Park
Edgar Allan Poe NHS	Kennesaw Mountain NBP	Thomas Edison NHP
Eugene O'Neill NHS	Korean War Veterans Memorial	Thomas Jefferson Memorial
Federal Hall N MEM	Lincoln Memorial	Thomas Stone NHS
Fire Island NS	Lyndon Baines Johnson Memorial Grove	Ulysses S Grant NHS
Ford's Theatre NHS	Manassas NBP	Valley Forge NHP
Fort McHenry NM & Historic Shrine	Martin Luther King Jr NHS	Vietnam Veterans Memorial
Fort Necessity NB	Mary McLeod Bethune Council House NHS	Washington Monument
Fort Point NHS	Mojave N PRES	Weir Farm NHS
Fort Washington Park	Monocacy NB	William Howard Taft NHS
Franklin Delan Roosevelt Memorial	Morristown NHP	Wolf Trap NP for the Performing Arts
Frederick Douglass NHS	Muir Woods NM	Yosemite NP
Friendship Hill NHS	National Mall & Memorial Parks	
Gateway NRA	Pennsylvania Avenue NHS	

Appendix B: Atmospheric Deposition Condition Adjustments

Atmospheric Sulfur Deposition

National assessments identified ecosystems and resources in national parks at risk for acidification and excess nitrogen enrichment. The reports provide a relative risk assessment of acidification impacts from atmospheric deposition for 270 parks in 32 inventory & monitoring networks. Ecosystem sensitivity relative ratings to acidification from atmospheric deposition were based on percent sensitive vegetation types, number of high-elevation lakes, length of low-order streams, length of high-elevation streams, average slope, and acid-sensitive areas within the park (Sullivan et al. 2011a). If park ecosystems are ranked very high in sensitivity to acidification effects from atmospheric deposition relative to all inventory & monitoring parks, the condition category is adjusted to the next worse condition category.

NPS units with very high ecosystem sensitivity ranking for acidification impacts (Sullivan et al. 2011a)	
Acadia NP	Little River Canyon N PRES
Allegheny Portage Railroad NHS	Marsh - Billings - Rockefeller NHP
Antietam NB	Morristown NHP
Apostle Islands NL	New River Gorge NR
Big South Fork NRRA	Obed WSR
Blue Ridge PKWY	Pictured Rocks NL
Bluestone NSR	Saint-Gaudens NHS
Buffalo NR	Shenandoah NP
Carl Sandburg Home NHS	Upper Delaware SRR
Catoctin Mountain Park	Voyageurs NP
Chickamauga & Chattanooga NMP	Carlsbad Caverns NP
Chesapeake & Ohio Canal NHP	Curecanti NRA
Crater Lake NP	Death Valley NP
Cumberland Gap NHP	Grand Canyon NP
Denali NP & PRES	Great Sand Dunes NP & PRES
Delaware Water Gap NRA	Grand Teton NP
Fort Necessity NB	Mount Rainier NP
Gauley River NRA	North Cascades NP
Glacier NP	Olympic NP
Great Basin NP	Rocky Mountain NP
Great Smoky Mountains NP	Saint Croix NSR
Harpers Ferry NHP	Sequoia & Kings Canyon NPs
Johnstown Flood N MEM	Wind Cave NP
Lake Clark NP & PRES	Yellowstone NP
Lassen Volcanic NP	Yosemite NP

Atmospheric Nitrogen Deposition

National assessments identified ecosystems and resources in national parks at risk for acidification and excess nitrogen enrichment. The reports provide a relative risk assessment of nutrient enrichment impacts from atmospheric deposition for 270 parks in 32 inventory & monitoring networks. Ecosystem sensitivity relative ratings to nutrient enrichment effects from atmospheric nitrogen deposition were based on percent sensitive vegetation types and number of high-elevation lakes within the park (Sullivan et al. 2011b). If park ecosystems are ranked very high in sensitivity to nutrient enrichment effects from atmospheric deposition relative to all inventory & monitoring parks the condition category is adjusted up one category.

NPS units with very high ecosystem sensitivity ranking for nutrient enrichment impacts (Sullivan et al. 2011b)	
Agate Fossil Beds NM	Joshua Tree NP
Arches NP	Lava Beds NM
Big Bend NP	Lake Mead NRA
Big Cypress N PRES	Little Bighorn Battlefield NM
Cabrillo NM	Manzanar NHS
Casa Grande Ruins NM	Montezuma Castle NM
Canyonlands NP	Mojave N PRES
Carlsbad Caverns NP	Mount Rainier NP
Chaco Culture NHP	North Cascades NP
Congaree NP	Olympic NP
Coronado N MEM	Organ Pipe Cactus NM
Curecanti NRA	Pecos NHP
Death Valley NP	Petrified Forest NP
Dinosaur NM	Petroglyph NM
Fossil Butte NM	Rocky Mountain NP
Fort Davis NHS	Saint Croix NSR
Fort Pulaski NM	Saguaro NP
Fort Union NM	Salinas Pueblo Missions NM
Gila Cliff Dwellings NM	Scotts Bluff NM
Golden Spike NHS	Sequoia & Kings Canyon NPs
Grand Canyon NP	Tallgrass Prairie N PRES
Great Sand Dunes NP & PRES	Tonto NM
Grand Teton NP	Washita Battlefield NHS
Guadalupe Mountains NP	Wind Cave NP
Hagerman Fossil Beds NM	Yellowstone NP
Hovenweep NM	Yosemite NP
John Day Fossil Beds NM	

Appendix C: Overall Air Quality Condition Adjustments

Where the NPS unit falls within a county designated by the EPA as "nonattainment" (not meeting) for the ground-level ozone standards of an 8-hour average concentration of 75 ppb, the overall air quality condition is automatically placed in the *Warrants Significant Concern* category for NPS units that are in ozone non-attainment counties. See Appendix A for a list of NPS units in ozone nonattainment counties.

The overall air quality condition category is also adjusted to the *Warrants Significant Concern* category when an NPS unit falls within an EPA designated nonattainment county for particulate matter ($PM_{2.5}$) standard of a 24-hour concentration of 35 micrograms per cubic meter ($\mu g/m^3$) See table below for a list of NPS units in $PM_{2.5}$ nonattainment counties.

NPS units in EPA designated 24-hour $PM_{2.5}$ nonattainment counties (2006 Standard)	
African Burial Ground NM	John Muir NHS
Allegheny Portage Railroad NHS	Johnstown Flood N MEM
Castle Clinton NM	Morristown NHP
Cuyahoga Valley NP	Muir Woods NM
Delaware Water Gap NRA	Point Reyes NS
Devils Postpile NM	River Raisin NB
Edgar Allan Poe NHS	Rosie the Riveter WWII Home Front NHP
Eugene O'Neill NHS	Sagamore Hill NHS
Federal Hall N MEM	Saint Paul's Church NHS
Fire Island NS	San Francisco Maritime NHP
First Ladies NHS	Santa Monica Mountains NRA
Fort Point NHS	Sequoia & Kings Canyon NPs
Gateway NRA	Statue Of Liberty NM
General Grant N MEM	Thaddeus Kosciuszko N MEM
Golden Gate NRA	Theodore Roosevelt Birthplace NHS
Golden Spike NHS	Thomas Edison NHP
Governors Island NM	Timpanogos Cave NM
Great Smoky Mountains NP	Tumacácori NHP
Hamilton Grange N MEM	Upper Delaware SRR
Hopewell Furnace NHS	Valley Forge NHP
Independence NHP	Weir Farm NHS
James A Garfield NHS	Yosemite NP

Appendix D: Visibility Natural Conditions

Natural visibility conditions are those estimated to exist in a given area in the absence of human-caused visibility impairment. The Clean Air Act established a goal of restoring visibility in all Class I areas to natural conditions (EPA-454/B-03-005). Interpolated average natural visibility is used within the contiguous U.S. For sites outside the contiguous U.S., average natural visibility is based on natural visibility estimates at a specific monitor (Denali NP & PRES, Virgin Islands NP, Hawaii Volcanoes NP, and Haleakala NP).

NPS Unit	Average Natural Condition
Abraham Lincoln Birthplace NHS	7.5
Acadia NP	7.4
Adams NHS	7.8
African Burial Ground NM	8.1
Agate Fossil Beds NM	3.7
Alcatraz Island	7.6
Alibates Flint Quarries NM	4.3
Allegheny Portage Railroad NHS	7.4
Amistad NRA	3.7
Anacostia Park	7.7
Andersonville NHS	7.5
Andrew Johnson NHS	7.1
Antietam NB	7.4
Apostle Islands NL	6.9
Appomattox Court House NHP	7.3
Arches NP	3.0
Arkansas Post NMem	7.4
Arlington House Robert E. Lee	7.7
Assateague Island NS	7.8
Aztec Ruins NM	2.8
Badlands NP	4.2
Baltimore Washington PWKY	7.7
Bandelier NM	2.6
Battleground NC	7.7
Bents Old Fort NHS	3.0
Big Bend NP	3.7
Big Cypress NPres	7.2
Big Hole NB	3.3
Big South Fork NR and NRA	7.4
Big Thicket NPres	7.0
Bighorn Canyon NRA	3.0
Biscayne NP	7.1

NPS Unit	Average Natural Condition
Black Canyon of the Gunnison NP	2.6
Blue Ridge Parkway	7.3
Bluestone NSR	7.3
Booker T. Washington NM	7.4
Boston African American NHS	7.6
Boston Harbor Islands NRA	7.8
Boston NHP	7.7
Brices Cross Roads NBS	7.5
Brown V Board of Education NHS	7.2
Bryce Canyon NP	3.1
Buffalo NR	7.2
Cabrillo NM	4.6
Canaveral NS	7.7
Cane River Creole NHP	7.4
Canyon de Chelly NM	3.0
Canyonlands NP	3.0
Cape Cod NS	8.4
Cape Hatteras NS	9.1
Cape Lookout NS	9.2
Capitol Reef NP	3.1
Capulin Mountain Volcano NM	2.8
Carl Sandburg Home NHS	6.9
Carlsbad Caverns NP	3.2
Carter G. Woodson NHS	7.7
Casa Grande NM	4.2
Castillo San Marcos NM	7.7
Castle Clinton NM	8.1
Catoctin Mountain Park	7.5
Cedar Breaks NM	3.4
Cedar Creek & Belle Grove NHP	7.1
Chaco Culture NHP	2.7
Chamizal NMem	3.3
Channel Islands NP	4.5
Charles Pickney NHS	8.2
Chattahoochee River NRA	7.4
Chesapeake and Ohio Canal NHP	7.4
Chickamauga and Chattanooga NMP	7.5
Chickasaw NRA	6.2
Chimney Rock NHP	3.8
Chiricahua NM	3.6
City of Rocks NR	3.5

NPS Unit	Average Natural Condition
Clara Barton NHS	7.7
Colonial NHP	7.9
Colorado NM	2.7
Congaree Swamp NM	7.7
Coronado NMem	3.9
Cowpens NB	7.2
Crater Lake NP	3.4
Craters of the Moon NM	3.7
Cumberland Gap NHP	7.3
Cumberland Island NS	7.7
Curecanti NRA	2.5
Cuyahoga Valley NP	7.5
Dayton Aviation Heritage NHP	7.4
De Soto NMem	7.6
Death Valley NP	4.2
Delaware Water Gap NRA	7.6
Denali NP & Pres	3.2
Devils Postpile NM	3.4
Devils Tower NM	3.7
Dinosaur NM	2.6
Dry Tortugas NP	7.3
Ebey's Landing NHR	5.3
Edgar Allan Poe NHS	7.8
Edison NHS	8.1
Effigy Mounds NM	7.1
Eisenhower NHS	7.5
El Malpais NM	3.0
El Morro NM	2.9
Eleanor Roosevelt NHS	7.2
Eugene O Neill NHS	6.6
Everglades NP	7.1
Federal Hall NM	8.1
Fire Island NS	7.6
First Ladies NHS	7.5
Flight 93 NM	7.4
Florissant Fossil Beds NM	2.7
Ford's Theater NHS	7.7
Fort Bowie NHS	3.6
Fort Caroline NMem	7.7
Fort Davis NHS	3.4
Fort Donelson NC	7.5

NPS Unit	Average Natural Condition
Fort Dupont Park	7.7
Fort Foote Park	7.7
Fort Frederica NM	7.7
Fort Laramie NHS	3.4
Fort Larned NHS	5.4
Fort Matanzas NM	7.7
Fort McHenry NM & Hist Shrine	7.7
Fort Necessity NB	7.2
Fort Point NHS	7.9
Fort Pulaski NM	7.9
Fort Raleigh NHS	9.1
Fort Scott NHS	7.2
Fort Smith NHS	7.2
Fort Stanwix NM	7.0
Fort Sumter NM	8.2
Fort Union NM	2.6
Fort Union Trading Post NHS	4.6
Fort Vancouver NHS	5.3
Fort Washington Park	7.7
Fossil Butte NM	2.8
Frederick Douglas NHS	7.7
Frederick Law Olmsted NHS	7.6
Fredericksburg & Spotsylvania NMP	7.3
Fredericksburg NC	7.4
Friendship Hill NHS	7.2
Gateway NRA	8.1
Gauley River NRA	7.2
General Grant NM	8.1
George Rogers Clark NHP	7.5
George Washington Birthplace NM	7.7
George Washington Carver NM	7.2
George Washington Mem PKWY	7.7
Gettysburg NMP	7.5
Gila Cliff Dwellings NM	2.9
Glacier NP	4.2
Glen Canyon NRA	3.1
Gloria Dei (Old Swedes) Church NHS	7.8
Golden Gate NRA	8.4
Golden Spike NHS	3.2
Governors Island NM	8.1
Grand Canyon NP	3.5

NPS Unit	Average Natural Condition
Grand Portage NM	6.8
Grand Teton NP	2.7
Grant-Kohrs Ranch NHS	3.2
Great Basin NP	3.0
Great Sand Dunes NP & Pres	2.8
Great Smoky Mountains NP	7.2
Green Springs Historic Landmark Dist	7.0
Greenbelt Park	7.7
Guadalupe Mountains NP	3.1
Guilford Courthouse NMP	7.4
Gulf Islands NS	7.5
Hagerman Fossil Beds NM	3.5
Haleakala NP	4.9
Hamilton Grange NMem	8.0
Hampton NHS	7.6
Harmony Hall	7.7
Harpers Ferry NHP	7.4
Harry S. Truman NHS	7.3
Hawaii Volcanoes NP	4.9
Herbert Hoover NHS	7.5
Hohokam Pima NM	4.3
Home of Franklin D. Roosevelt NHS	7.2
Homestead NM of America	7.0
Hopewell Culture NHP	7.4
Hopewell Furnace NHS	7.6
Horseshoe Bend NMP	7.6
Hot Springs NP	7.2
Hovenweep NM	2.9
Hubbel Trading Post NHS	3.0
Ice Age National Scenic Trail	7.2
Illinois & Michigan Canal NHC	7.4
Independence NHP	7.8
Indiana Dunes NL	7.4
International Peace Garden	4.9
Isle Royale NP	6.7
James A. Garfield NHS	7.5
Jean Lafitte NPres	7.5
Jefferson National Expansion Mem NHS	7.5
Jewel Cave NM	3.8
Jimmy Carter NHS	7.5
John D. Rockefeller, Jr. Mem Parkway NM	2.7

NPS Unit	Average Natural Condition
John Day Fossil Beds NM	4.5
John Fitzgerald Kennedy NHS	7.6
John Muir NHS	7.0
Johnstown Flood NMem	7.4
Joshua Tree NP	4.2
Kennesaw Mountain NBP	7.4
Keweenaw NHP	6.7
Kings Canyon NP	4.1
Kings Mtn. NMP	7.3
Knife River Indian Villages NHS	4.6
Lafayette Square P	7.7
Lake Chelan NRA	4.1
Lake Mead NRA	3.8
Lake Meredith NRA	4.3
Lake Roosevelt NRA	4.1
Lassen Volcanic NP	3.7
Lava Beds NM	3.8
Lewis and Clark NHP	5.1
Lincoln Boyhood NMem	7.5
Lincoln Home NHS	7.5
Little Bighorn NM	3.3
Little River Canyon NPres	7.5
Little Rock Central High School NHS	7.3
Longfellow NHS	7.6
Lowell NHP	7.3
Lyndon B. Johnson NHP	5.2
Lyndon Baines Johnson NMem	7.7
Maggie L. Walker NHS	7.5
Mammoth Cave NP	7.5
Manassas NBP	7.4
Manzanar NHS	4.2
Marsh-Billings_Rockefeller NHP	6.5
Martin Luther King, Jr. NHS	7.4
Martin Van Buren NHS	6.6
Mary McLeod Bethune Council House NHS	7.7
McLoughlin House NHP	5.3
Mesa Verde NP	2.8
Minidoka Internment NM	3.5
Minute Man NHP	7.4
Minuteman Missile NHS	4.5
Mississippi NRA	7.1

NPS Unit	Average Natural Condition
Missouri NRR	6.2
Mojave NPres	4.0
Monocacy NB	7.5
Montezuma Castle NM	3.6
Moores Creek NB	8.1
Morristown NHP	7.9
Mount Rainier NP	4.6
Mount Rushmore NMem	3.8
Muir Woods NM	8.1
Natchez NHP	7.5
Natchez Trace Parkway	7.5
National Capital Parks - East	7.7
National Capital Parks NRA	7.7
National Mall	7.7
National Mall & Memorial Parks	7.7
Natural Bridges NM	3.0
Navajo NM	3.1
New Bedford Whaling NHP	8.4
New River Gorge NR	7.2
Nez Perce NHP	4.1
Nicodemus NHS	5.2
Ninety Six NHS	7.3
Niobrara NSR	4.9
North Cascades NP	4.3
Obed Wild and Scenic River	7.4
Ocmulgee NM	7.5
Olympic NP	5.1
Oregon Caves NM	5.5
Organ Pipe Cactus NM	4.4
Oxon Cove Park and Oxon Hill Park	7.7
Ozark NSR	7.3
Padre Island NS	5.5
Palo Alto Battlefield NHS	5.4
Parashant NM	3.6
Pea Ridge NMP	7.2
Pecos NHP	2.8
Pennsylvania Avenue NHS	7.7
Perrys Victory and International Peace M	7.4
Petersburg NB	7.6
Petrified Forest NP	3.1
Petroglyph NM	2.8

NPS Unit	Average Natural Condition
Pictured Rocks NL	6.6
Pinnacles NM	5.2
Pipe Spring NM	3.5
Pipestone NM	7.1
Piscataway Park	7.7
Point Reyes NS	8.6
Poverty Point NM	7.4
Presidio of San Francisco	7.8
Prince William Forest Park	7.6
Rainbow Bridge NM	3.2
Redwood NP	6.6
Richmond NBP	7.6
Rock Creek P	7.7
Rocky Mountain NP	2.7
Roger Williams NMem	7.7
Rosie the Riveter WWII Home Front NHP	7.6
Ross Lake NRA	4.2
Russell Cave NM	7.5
Sagamore Hill NHS	7.8
Saguaro NP	3.8
Saint Croix Island IHS	7.6
Saint Croix NSR	7.0
Saint Pauls Church NHS	8.0
Saint-Gaudens NHS	6.5
Salem Maritime NHS	7.7
Salinas Pueblo Missions NM	3.2
San Antonio Missions NHP	5.2
San Francisco Maritime NHP	7.6
San Juan Island NHP	5.1
Sand Creek Massacre NHS	3.6
Santa Monica Mountains NRA	4.0
Saratoga NHP	6.3
Saugus Iron Works NHS	7.6
Scotts Bluff NM	3.7
Sequoia / Kings Canyon NP	4.2
Sequoia NP	4.4
Shenandoah NP	6.9
Shiloh NMP	7.5
Sleeping Bear Dunes NL	6.8
Springfield Armory NHS	6.7
Statue of Liberty NM	8.1

NPS Unit	Average Natural Condition
Steamtown NHS	7.4
Stones River NB	7.5
Sunset Crater NM	3.3
Tallgrass Prairie NPres	6.9
Thaddeus Kosciuszko NMem	7.8
The Old Stone House	7.7
Theodore Roosevelt Birthplace NHS	8.1
Theodore Roosevelt Inaugural NHS	7.5
Theodore Roosevelt NMem	7.7
Theodore Roosevelt NP	4.6
Thomas Stone NHS	7.7
Timpanogos Cave NM	3.1
Timucuan Ecological and Historical Prese	7.7
Tonto NM	4.0
Tumacacori NM	3.9
Tupelo NB	7.5
Tuskegee Airmen NHS	7.6
Tuskegee Institute NHS	7.6
Tuzigoot NM	3.5
Ulysses S. Grant NHS	7.4
Upper Delaware Scenic and Recreational R	7.4
Valley Forge NHP	7.7
Vanderbilt Mansion NHS	7.1
Vicksburg NC	7.4
Virgin Islands NP	6.7
Voyageurs NP	7.1
Walnut Canyon NM	3.4
Washington Monument	7.7
Washita Battlefield NHS	5.1
Weir Farm NHS	7.4
Whiskeytown NRA	4.0
White Sands NM	3.2
Whitman Mission NHS	4.3
William Howard Taft NHS	7.4
Wilsons Creek NB	7.2
Wind Cave NP	3.8
Wolf Trap Farm Park	7.6
Womens Rights NHP	7.2
Wright Brothers NMem	8.9
Wupatki NM	3.3

NPS Unit	Average Natural Condition
Yellowstone NP	2.6
Yosemite NP	3.4
Yucca House NM	2.8
Zion NP	3.6